

THREE NEW STENONEMA SPECIES FROM EASTERN NORTH AMERICA
(HEPTAGENIIDAE: EPHEMEROPTERA)

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ABSTRACT—Three new species of *Stenonema* mayflies, *S. carlsoni*, *S. quinquespinnum* and *S. floridense*,¹ are described and illustrated. The accounts of each species include notes on the ecology and distribution. The diagnoses were based mostly on the arrangement of spines on the male genitalia and the number of spines and setae on the nymphal maxillae.

The three new species of *Stenonema* described in this report were discovered during the examination of field collections and museum holdings undertaken during the preparation of illustrated keys and ecological notes for the species within this genus (Lewis, 1974).

During the course of this study approximately 500 adults and 1,000 nymphs were collected by the author, and about 300 of the nymphs were reared to imagos. The Ephemeroptera collections were examined at the Illinois Natural History Survey, containing Dr. Burks' collection; Cornell University, containing Dr. Traver's collection; the Entomological Research Institute of Canada, containing Dr. Clemens' and Dr. McDunnough's collections; Harvard University Museum of Comparative Zoology, containing Dr. Banks' and Dr. Walsh's collections; Florida A&M University; and the University of Wisconsin.

Type specimens are deposited at the Illinois Natural History Survey, Urbana (INHS); University of Wisconsin, Madison, (UW); U.S. Environmental Protection Agency, Cincinnati, (EPA); and Florida A&M University, Tallahassee, (FAM).

The information presented on each of these new taxa includes a nymphal and adult description and diagnosis, ecological notes, collection records, and a distribution map.

Stenonema carlsoni Lewis, new species
fig. 1,4,8,13,16,18

NYMPH—Length of body, 12–14 mm.

Head: Dark brown, freckled with pale dots; area lateral to eyes pale. Maxillae with armature on crowns consisting of 7–9 pectinate spines but lacking setae; ventral surfaces of galea-laciniae with 25–45 lateral setae (fig. 1). Mandibles with 8–10 teeth on inner margin of each outer canine (fig. 4).

¹This species would fall into the new genus *Stenacron* Jensen (Proc. Entomol. Soc. Wash. 76(2):225–228, 1974) which was published as this paper went to press.

Thorax: Dark brown; pronotum with large pale spots near lateral margins. Dorsal surface of femora with 3 irregular dark bands and 3 white bands; tibiae pale with basal and median brown bands; basal half of each tarsus dark, remainder pale; claws not pectinate.

Abdomen: Pale tan with broken median dark line dorsally on segments 2-8. Terga 1, 8, and 9 mostly pale in median area; terga 2-5 and 7 with large pale submedian areas set off by brown lateral patches and median dark brown line; terga 6 and 10 mostly dark brown (fig. 8). Sterna pale with faint dots and bars barely visible in median area of segments 2-9, sometimes with lateral dark shading near margins of sternum 9. Posterolateral angles of segments 3-9 extended as spines, those on segments 3-5 usually very small. Gills 1-6 truncate at apices, 7th gill with fringe of hairs but lacking tracheae. Caudal filaments uniformly tan with rings of stout black setae at articulations.

MALE IMAGO—Length: Body, 9-12 mm; fore wings, 10-14 mm; tails, 20-26 mm.

Head: Yellowish brown, ocelli black-ringed at bases; usually a black or purple transverse line across face ventral to antennal sockets.

Thorax: Light brown with reddish cast; mesonotum lighter yellow-brown. Mesoscutellum dark brown. Legs yellowish tan; wide dark median and apical bands on each femur; remainder of legs mostly pale tan with dark shading near joints; fore tarsal ratio, 1.5-2.0 (ratio of length of 2nd tarsal segment to length of 1st tarsal segment). Fore wings hyaline with crossveins crowded in first 6-8 interspaces of bulla region, these crossveins sometimes forming a dark curved streak across wings; reddish-brown stain in costal and subcostal interspaces of stigmatic area; elongated cells in discal area proximal to bulla region (fig. 16). Hind wings with wide brown band at apical margin (fig. 16).

Abdomen: Tawny with brownish lateral areas and narrow black or brown posterior margins on each tergum (fig. 18). Genitalia distinctly boot-shaped, penis lobes with straight apical margins, apical spines minute, and discal spines of moderate size (fig. 13). Caudal filaments yellowish white; articulations brown.

HOLOTYPE: Male imago; Wildcat Creek, Pickens County, SOUTH CAROLINA 26-VII-68; collected and reared by P. H. Carlson; deposited in Florida A&M University collection.

ALLOTYPE: Female imago; University Creek, Athens, Clarke County, GEORGIA 2-IV-49; collected by Rickert and Scott; deposited in INHS.

PARATYPES: One mature nymph, 32 male imagos and 23 female imagos; same location as holotype; collected between 1-III-68 and 22-VIII-68 by P. H. Carlson; deposited in FAM, INHS, and EPA. Six mature nymphs; tributary to Eighteen Mile Creek, 1 m.w. of U.S. Highway 76, Anderson County, SOUTH CAROLINA 1-VI-66; collected by R. Prins; deposited in FAM. One mature nymph; University Creek, Athens, Clarke County, GEORGIA 2-IV-49; collected by Rickert and Scott; deposited in INHS. Three mature nymphs; Pine Mountain State Park, Bell County, KENTUCKY 18-VI-58; collected by W. L. Peters; deposited in FAM.

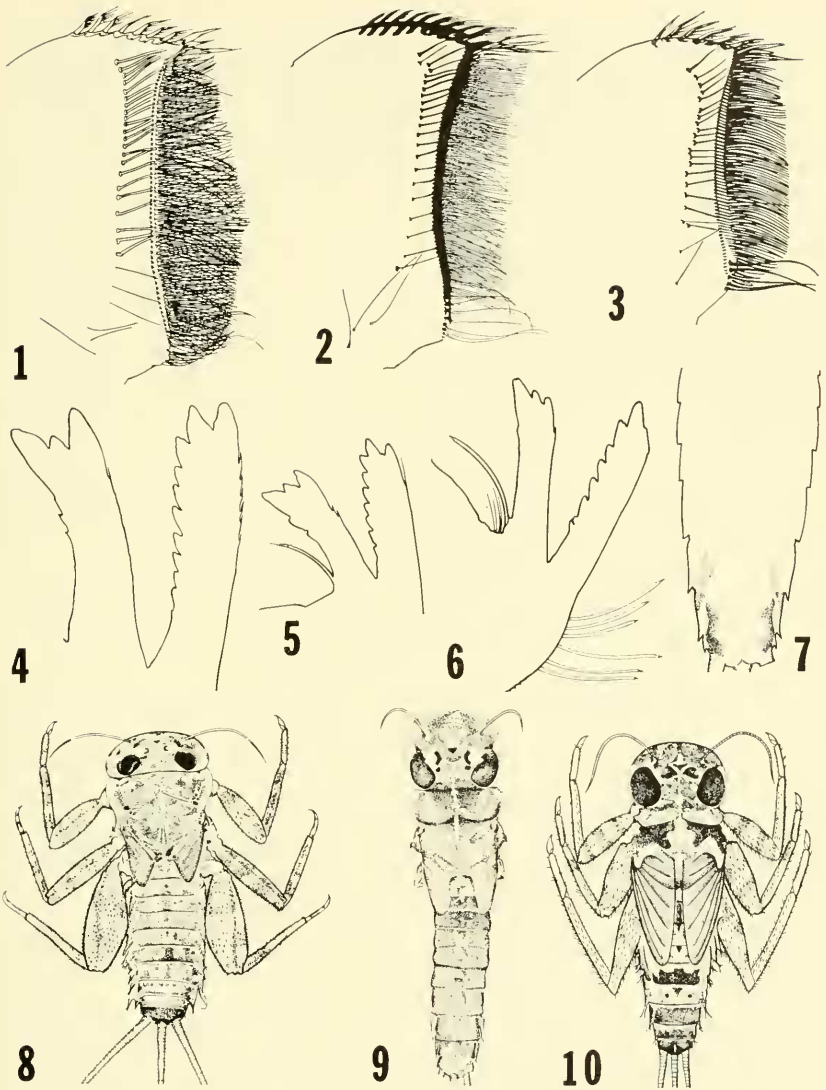


Fig. 1-3. *Stenonema* spp., maxillae. 1, *carlsoni*; 2, *floridense*; 3, *quinquespinum*.
 Fig. 4-6. *Stenonema* spp., mandibles. 4, *carlsoni*; 5, *floridense*; 6, *quinquespinum*.
 Fig. 7. *Stenonema floridense*, abdomen, dorsal view. Fig. 8-10. *Stenonema* spp., nymphs, dorsal view. 8, *carlsoni*; 9, *floridense*; 10, *quinquespinum*.

Ecology and Distribution: This species is common in the mountain streams of Georgia and South Carolina (fig. 19) where it apparently replaces the closely related species *S. pudicum* (Hagen), which is common in mountain streams from North Carolina to New York.

Nothing is known of the pollution tolerance of *S. carlsoni* but its distribution suggests that it prefers clean water.

Discussion: Both nymphs and imagos of *S. carlsoni* are superficially quite similar to those of *S. pudicum*, with which it has previously been confused. All the specimens labeled "*S. pudicum*" that I have seen in FAM collection from South Carolina and Georgia were found to be *S. carlsoni*. Nymphs of *S. carlsoni* can be distinguished from *S. pudicum* by the number of spines and setae on the crowns of the maxillae. In *S. carlsoni* the crowns of the maxillae are armed with 7-9 pectinate spines and lack setae, whereas those of the maxillae of *S. pudicum* have 5-8 pectinate spines and 20-40 crown setae. The adult of *S. carlsoni* lacks the dark sagittate mark in the median area of each tergum that is so characteristic of *S. pudicum*, and the dark posterior margin of each tergum in *S. carlsoni* is much narrower than that in *S. pudicum*. The penis lobes of *S. pudicum* have subterminal spines, whereas those of *S. carlsoni* have discal spines.

Etymology: The name is in honor of Paul H. Carlson, who collected and reared the species from Wildcat Creek, South Carolina, and sent the type material for examination.

Steunonema floridense Lewis, new species
fig. 2,5,7,9,14,17

NYMPH—Length of body, 8-10 mm.

Head: Uniform brown anterior to compound eyes and on vertex; usually small median white spot at anterior margin; larger white spots lateral to each compound eye. Maxillae with armature on the crowns consisting of 8 or 9 heavy comblike spines, but lacking setae; ventral surface of galea-laciniae with 20-25 lateral setae (fig. 2). Mandibles with 7 teeth on inner margin of each outer canine (fig. 5).

Thorax: Uniform brown except for 4 white spots on pronotum, one near each anterolateral angle and one at each anterior margin midway between meson and lateral margins; a few small white dots on mesonotum at base of wing pads. Legs brown dorsally; each femur with 3 irregular rows of white spots, these spots much larger on fore legs and middle legs than on hind legs; venter mostly pale; claws not pectinate.

Abdomen: Mostly brown; an interrupted row of elongated white spots on both sides of meson; these narrow elongate spots nearly continuous as pale lines on terga 1-4 and 9; the spots meet on tergum 8 so that mid-dorsal area mostly white; other terga often without submedian white spots; terga 2-7 with white spots at lateral margins and midway between lateral margins and meson (fig. 9). Sterna 1-8 mostly pale; sternum 9 (and sometimes 7 and 8) with lateral brown bands (fig. 7). Posterolateral angles of segments 7-9 extended as spines. Gills 1-6 pointed at apices; 7th gill with tracheae but without a fringe of hairs. Caudal filaments very light brown.

MALE IMAGO—Length: Body, 7-9 mm; fore wings, 8 mm; tails, 15-22 mm.

Head: Pale yellowish white; ocelli black ringed at bases; face below antennal sockets typically without black markings, but sometimes with faint black dots, dashes or an unbroken line; reddish-brown shading and gray dots on vertex.

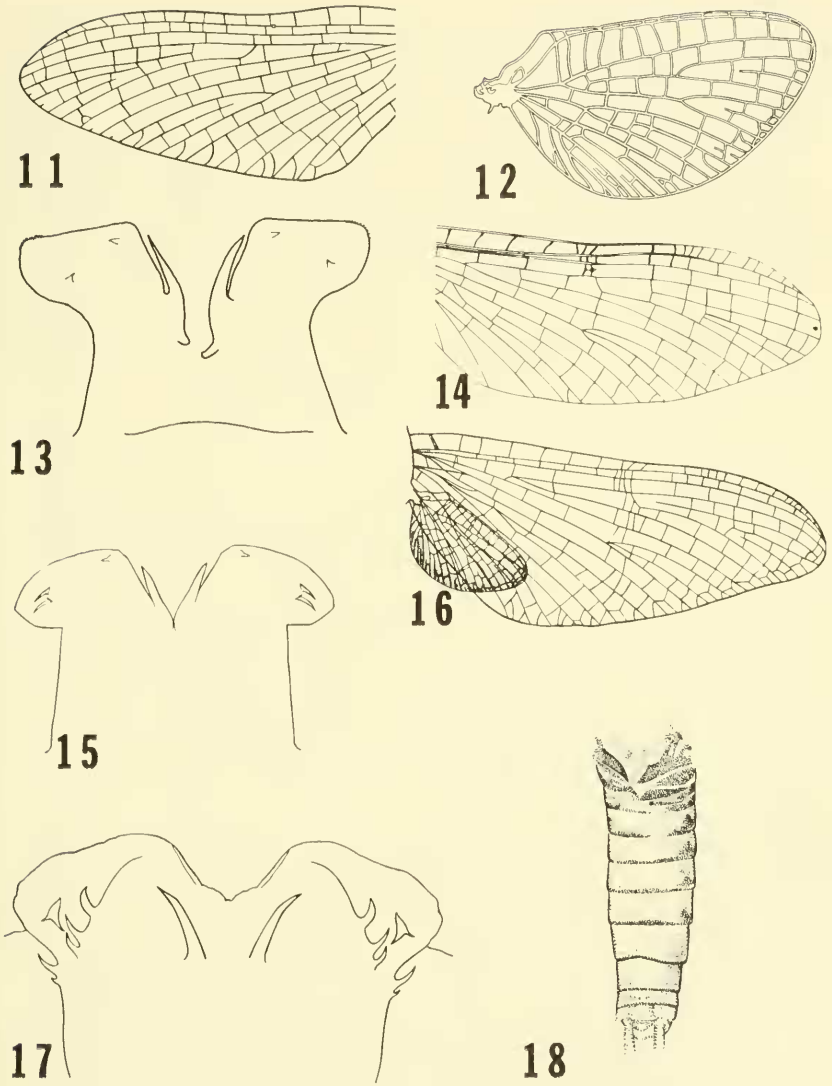


Fig. 11-18. *Stenonema* spp., adult parts, dorsal views. 11, *quinquespinum*, fore wing; 12, *quinquespinum*, hind wing; 13, *carlsoni*, male genitalia; 14, *floridense*, fore wing; 15, *quinquespinum*, male genitalia; 16, *carlsoni*, wings; 17, *floridense*, male genitalia; 18, *carlsoni*, female abdomen.

Thorax: Light yellow-brown; 2 black streaks on pronotum; mesoscutellum white. Legs greenish yellow or white; faint reddish-brown median and apical bands on femora, median band usually missing from hind femora; apex of tibiae brown; fore tarsal ratio, 2.0–2.4. Fore wings hyaline; dark dash at bulla connecting 2 or more crossveins or this dash reduced to small black dots (fig. 14). Hind wings with dark apical margins.

Abdomen: Hyaline with narrow black line at posterior margin of each tergum; no spiracular dots; alabaster white pigment on dorsum of segments 8 and 9. Genitalia with large lateral spines, 2–4 large curved axial spines, which may be three-lobed; a discal spine; and an apical spine either minute or apparently absent (fig. 17). Caudal filaments light gray throughout.

HOLOTYPE: Male imago; Blackwater River, nr. Holt, Okaloosa County, FLORIDA 21-IV-72; collected by W. L. Peters and P. H. Carlson; deposited in Florida A&M University collection.

ALLOTYPE: Female imago; Blackwater River, Blackman, Okaloosa County, FLORIDA 1-V-70; collected by W. L. Peters and P. T. P. Tsui; deposited in FAM.

PARATYPES: One male imago; same data as holotype; deposited in FAM. One male imago and one female imago; Blackwater River, nr. Holt, Okaloosa County, FLORIDA 28-IV-72; collected by W. L. Peters, J. G. Peters, and P. H. Carlson; deposited in FAM. One male imago; Blackwater River, W of Holt, Santa Rosa County, FLORIDA 4-IX-71; collected by W. L. Peters; deposited in FAM. One male imago; Rocky Comfort Creek, S. of State Route 268, Gadsden County, FLORIDA 10-VI-70; collected by J. Jones; deposited in FAM. One mature nymph; Blackwater River, Blackman, Okaloosa County, FLORIDA 27-IV-72; collected by W. L. Peters and P. H. Carlson; deposited in FAM.

Ecology and Distribution: This species is common in the panhandle of Florida and is the only species of the *Interpunctatum* group found on the sandy bottom of the streams of the Blackwater River Basin of Santa Rosa and Okaloosa Counties. Most of the streams in this basin result from ground water and are relatively swift, and the shifting sand is in almost constant motion. The water is extremely soft and is low in minerals and nutrients. Beek (1973) reported the following chemical data: pH, varying from 5.0–6.3; total dissolved solids, 15–17 mg/l; and dissolved oxygen (DO) 6.8–9.7 mg/l.

Stenonema floridense is restricted to the naturally acid streams of the southeast that have not been affected by pollution (fig. 19).

Discussion: This species superficially resembles *S. interpunctatum*. However, the armature of the male genitalia (fig. 17) is distinct from that of any other species. None of the *S. floridense* specimens examined showed any trace of black pleural streaks or black spiracular spots. Otherwise, the color characters vary considerably as in *S. interpunctatum*.

Nymphs of *S. floridense* can usually be separated from *S. interpunctatum* by the presence of 8 pectinate spines (rather than 9 or 10 as in *S. interpunctatum*) on the crown of the maxillae. However, nymphs of *S. floridense* occasionally have 9 spines on the crown of each maxilla. Unlike *S. interpunctatum* nymphs, *S. floridense* specimens have the following combination of distinguishing characters: 7 teeth on the inner margin of the outer canine, 4 teeth on the inner margin of the inner canine, less than 25 lateral setae on the ventral surface of the galea-lacinia of each maxilla, and a dorsal pattern of interrupted elongate pale spots.

Etymology: The name refers to its presently known distribution.

Stenonema quinquespinum Lewis, new species
fig. 3,6,10,11,12,15

NYMPH—Length of body, 9–10 mm.

Head: Dark brown with numerous frecklelike white dots anterior to eyes and on vertex between eyes, some of the white dots converging to form irregular pale spots; pale area lateral to compound eye divided by a brown band; each ocellus surrounded by large pale spot (middle spot shaped like arrowhead); a small pale spot on vertex near posterior margin of head. Scapes of antennae pale; pedicels and basal segments of flagella black; remainder of antennae pale. Maxillae with armature on the crown consisting of 4–6 (usually 5) pectinate spines but lacking setae; ventral surfaces of galea-laciniae with 20–30 lateral setae (fig. 3). Mandibles with 7–8 teeth on inner margin of each outer canine (fig. 6).

Thorax: Brown with a few small pale spots, mostly in the mid-dorsal region; large pale spots at each lateral margin of pronotum extending anteromedially nearly to the anterior margin; a large pale spot near anterior margin midway between each lateral margin and mid-dorsal line. Femora pale, with 2 or 3 irregular brown bands across dorsal surface and some brown shading at apex; each tibia with a basal and median brown band; basal half of each tarsus brown; dense rows of hairs along posterior margins of fore legs; claws not pectinate.

Abdomen: Terga 1 and 2 mostly white; terga 7 and 9 pale on meson but dark brown laterally and with brown submedian spots near anterior margins; terga 6, 8, and 10 mostly brown with segment 10 darkest; remaining terga brown with pale dots posteriorly and a wide pale area near anterior margins (fig. 10). Sterna 1–7 pale, usually without dark markings; segments 8–9 usually with brown bands near lateral margins and brown spot on meson at anterior margins; segment 9 sometimes with brown band around posterior margin. Posterolateral angles of segments 7–9 produced as spines, those spines on segment 9 very small. Gills 1–6 truncate at apices, 7th gill with fringe of hairs but without tracheae. Caudal filaments banded with 2 segments pale and 2 segments brown alternating for length of filaments.

MALE IMAGO—Length; Body, 9 mm; fore wings, 9 mm; tails, 17–25 mm.

Head: White below antennal sockets; vertex yellow with varying amounts of orange shading, especially on posterior portion; eyes grey in life, turning black in alcohol.

Thorax: Yellow-brown; pale area on meson of mesonotum; pleuron white with pink or orange areas near coxae; mesoscutellum white. Fore femora light tan; remainder of legs white; each femur with reddish-brown bands at middle and apex; apex of each tibia black; fore tarsal ratio, 1.6. Fore wings hyaline, stigmatic area stained reddish brown (fig. 11). Hind wings with narrow brown band at apical margins (fig. 12).

Abdomen: White; terga 2-7 each with a narrow black line at posterior margin and small oblique black spiracular spots, terga 8-10 alabaster white, especially in mid-dorsal area. Genitalia with apical and discal spines (fig. 15); caudal filaments white with dark brown joints.

HOLOTYPE: Male imago with nymphal exuvia; East Fork of Little Miami River, Williamsburg, Clermont County, OHIO 1-V-72; collected and reared by P. A. Lewis; deposited in Florida A&M University collection.

ALLOTYPE: Female imago (reared); same data as holotype; deposited in FAM.

PARATYPES: Nine male imagos (reared), nine female imagos (reared) and five mature nymphs; same data as holotype; deposited in INHS, FAM, and EPA. Two male imagos (labeled *S. exiguum*); Oostanaula River, Rome, Floyd County, GEORGIA 15-VII-39; collected by P. W. Fattig; deposited in INHS. One male imago; Claw River, Burnett County, WISCONSIN 31-IV-72; collected by R. W. Flowers; deposited in UW. One mature nymph; Clam River, Burnett County, WISCONSIN 26-VI-72; collected by R. W. Flowers; deposited in UW.

Ecology and Distribution: Nymphs inhabit the middle reaches of medium sized rivers from Georgia to Wisconsin (fig. 19). Most of the streams from which this species was collected were affected by agricultural runoff and mild organic enrichment. However, this species is often replaced by *S. pulchellum* (Walsh) in more polluted areas below domestic waste discharges.

Discussion: *Stenonema quinquespinum* is closely related to *S. exiguum* Traver and *S. pulchellum*. However, male imagos of *S. quinquespinum* can be separated from *S. pulchellum* by the narrow apical brown border on each hind wing and the absence of terminal spines on the penis lobes. The presence of dark stigmal spots separates this species from *S. exiguum* and differences in spination of the penis lobes also appear to be diagnostic. Each penis lobe of *S. exiguum* has a subterminal spine, whereas *S. quinquespinum* possesses a discal spine. Differences in wing venation and genitalia separate this species from *S. integrum*, which has long cells in the discal area of the fore wings and terminal spines on the penis lobes. The absence of 2 dark dashes at the posterior margins of terga 2-8 serves to distinguish *S. quinquespinum* from *S. ares* and *S. bipunctatum*.



Fig. 19. Distribution map of *Stenonema carlsoni*, *S. floridense*, and *S. quinquespinum*.

Nymphs could be confused with either *S. exiguum* or *S. pulchellum* except for the lack of pectinations on the claws. They are further separated from *S. pulchellum* by the band of large white spots across the mesonotum at the wing bases.

Etymology: The name refers to the 5 pectinate spines on the crown of the maxillae.

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